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SPECIFICATION FOR STEELS FOR ELECTRICALLY WELDED ROUND LINK CHAINS

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NEW DELHI 110002

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Indian Standard

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Indian Standard

SPECIFICATION FOR STEELS FOR ELECTRICALLY WELDED ROUND LINK CHAINS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 15 March 1973, after the draft finalized by the Wrought Steel Products Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 For the benefit of the purchaser, an informative appendix (Appendix A) giving particulars to be specified by the purchaser while ordering chain steels has been included.

0.3 This standard contains clauses which call for agreement between the purchaser and the manufacturer. Such clauses are **3.1**, **8.1**, **9.1**, **12.1**, **12.1.1**, **13.1**, **14.2** and **14.3**.

0.4 This standard keeps in view the manufacturing and trade practices being followed in the country in this field.

0.5 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard covers the requirements for steels for electrically welded round link chains in the form of billets and bars.

2. SUPPLY OF MATERIAL

2.1 General requirements relating to the supply of material shall conform to IS : 1387-1967†.

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*Rules for rounding off numerical values (*revised*).

†General requirements for the supply of metallurgical materials (*first revision*).

2.2 Steels covered by this standard shall be ordered and delivered on any one of the basis given in Table 1.

TABLE 1 TYPES OF CONDITIONS OF DELIVERY

REQUIREMENTS	TYPES OF CONDITIONS OF DELIVERY										
	A	B	C	D	E	F	G	H	J	K	L
Chemical composition	X	X	X	X	X	X	X	X	X	X	X
Hardenability	—	—	X	X	—	—	—	X	X	—	—
Hardness in the annealed or normalized condition	—	X	—	X	—	X	—	—	X	—	X
Mechanical properties for heat treated test bars	—	—	—	—	X	X	—	—	—	X	X
Grain size	—	—	—	—	—	—	X	X	X	X	X

3. MANUFACTURE

3.1 Steel shall be manufactured by open hearth, electric, basic oxygen or a combination of these processes. In case any other process is employed by the manufacturer, prior approval of the purchaser should be obtained.

3.2 Steel shall be supplied in the fully killed condition.

4. FREEDOM FROM DEFECTS

4.1 The material shall be free from harmful internal and surface defects.

5. CHEMICAL COMPOSITION

5.1 Ladle Analysis — The ladle analysis of steel when tested in accordance with IS : 228-1959* shall be as given in Table 2.

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*Method of chemical analysis of pig iron, cast iron and plain carbon and low-alloy steels (*revised*).

TABLE 2 CHEMICAL COMPOSITION OF CHAIN STEELS

(*Clause* 5.1)

Steel Designation	Constituent, Percent						
	Carbon	Manganese	Nickel	Chromium	Molybdenum	Sulphur	Phosphorus
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
C15Mn$_{\underline{75}}$	0·10-0·20	0·60-0·90	—	—	—	0·04	0·04
C25Mn$_{\underline{75}}$	0·20-0·30	0·60-0·90	—	—	—	0·04	0·04
C30	0·25-0·35	0·60-0·90	—	—	—	0·04	0·04
20Mn2	0·16-0·24	1·30-1·70	—	—	—	0·04	0·04
20Ni$_{\underline{55}}$Cr$_{\underline{50}}$ Mo$_{\underline{20}}$	0·18-0·23	0·70-0·90	0·40-0·70	0·40-0·60	0·15-0·25	0·035	0·035

NOTE — In the case of silicon killed steel, a minimum of 0·1 percent silicon shall be maintained in the product analysis. When the steel is silicon-aluminium killed or aluminium killed, this limit shall not be made applicable.

5.2 Product Analysis — The product analysis shall be carried out on the finished product. The permissible variation in case of such product analysis from the limits specified in Table 2 shall be as follows:

Constituent	*Permissible Deviation in Product Analysis*
Carbon	0·03
Manganese	
Up to 1 percent	0·03
Above 1 percent	0·04
Nickel	0·03
Chromium	0·03
Molybdenum	
Up to 0·20 percent	0·01
Above 0·20 percent	0·02
Phosphorus	0·005
Sulphur	0·005

5.3 For the manufacture of high strength chains, the steels shall have the specified grain size (*see* **10**) or alternatively show sufficient content of aluminium or equivalent elements stabilizing the steel against embrittlement during service.

NOTE — A minimum of 0·020 percent metallic aluminium is generally quoted for guidance.

6. HEAT TREATMENT

6.1 The steel shall be supplied in the as-rolled, normalized or annealed condition.

6.1.1 Recommended temperature for annealing and normalizing are given in Appendix B.

6.2 Heat treatment for test bars in order to comply with the properties specified in Table 3 shall be as given in Appendix B.

6.3 Steel 20Ni55Cr50Mo20 may alternatively be subjected to single quench heat treatment provided the test bars comply with the mechanical properties specified in Table 3. The hardening temperatures are given in Appendix B.

TABLE 3 MECHANICAL PROPERTIES OF CHAIN STEELS

(*Clauses* 6.2, 6.3, 8.1, 8.1.1 *and* 8.2)

Steel Designation	Condition of Heat Treatment	Tensile Strength N/mm²*	Yield Strength N/mm²*, *Min*	Elongation, *Min*, percent $L_0 = 5\sqrt{S_0}$	U-Notch J/mm², *Min*, at 0°C	Limiting Ruling Section mm
C15Mn75	N	410-530	—	25		
C25Mn75	N	430-560	—	22		
C30	N	490-590	—	21		
	H and T	590-680	390	18		30
20Mn2	N	540-640	350	20		15
		540-640	320	20		30
		510-610	310	20		63
		510-610	290	20		100
		490-590	280	20		100 up to 150
	H and T	590-730	430	18		63
		690-830	490	16	70	30
20Ni55Cr50 Mo20	Refined & quenched	890	—	11	—	30

*1N/mm² = MN/m² = 0·102 0 kgf/mm².

7. HARDNESS

7.1 The maximum hardness for products delivered in the annealed or normalized condition when determined in accordance with IS : 1500-1968* shall be as given in Table 4.

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*Method for brinell hardness test for steel (*first revision*).

TABLE 4 MAXIMUM HARDNESS FOR PRODUCTS DELIVERED IN THE ANNEALED OR NORMALIZED CONDITION

(*Clause* 7.1)

STEEL DESIGNATION	BRINELL HARDNESS, HB, *Max*
C15Mn$\underline{75}$	154
C25Mn$\underline{75}$	184
C30	187
20Mn2	200
20Ni$\underline{55}$Cr$\underline{50}$Mo$\underline{20}$	213

8. MECHANICAL PROPERTIES

8.1 If required the mechanical properties of test bars after simulated heat treatment in accordance with Appendix B shall conform to the requirements given in Table 3.

8.1.1 The properties given in Table 3 shall be applicable to test bars taken on rounds in the direction of the fibre, the axis of which corresponds to Fig. 1.

8.2 Methods for determining the mechanical properties specified in Table 3 shall be in accordance with IS : 1608-1960[*] and IS : 1499-1959[†].

9. HARDENABILITY

9.1 For steels ordered on the basis of end quenched hardenability the requirements shall be mutually agreed to between the purchaser and the manufacturer.

9.1.1 The method of testing hardenability of steel shall be in accordance with IS : 3848-1966[‡].

10. GRAIN SIZE

10.1 Austenitic grain size, when tested in accordance with IS : 2853-1964[§], shall be 5 or finer in the case of steels required for the manufacture of high strength chains.

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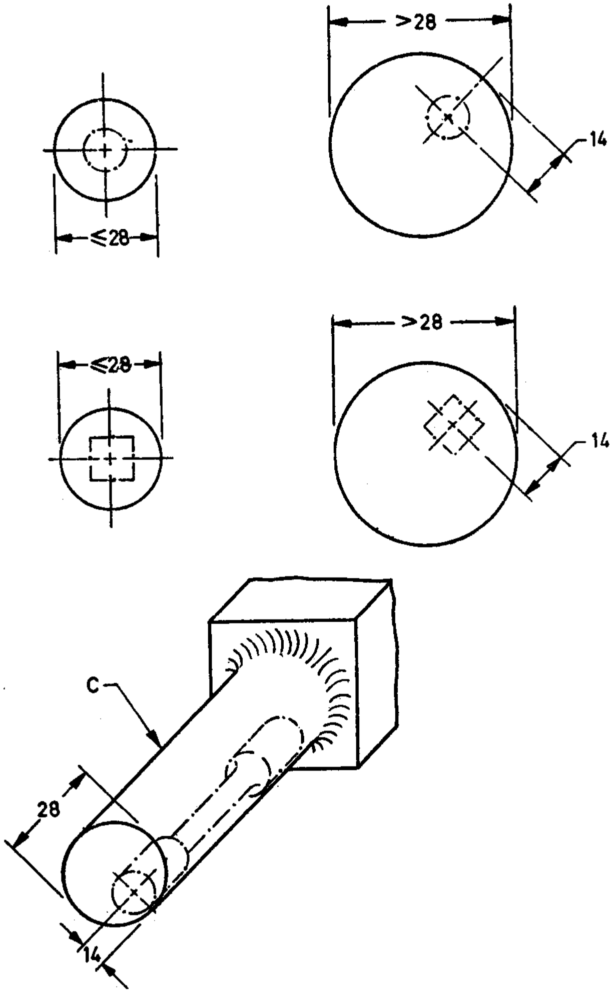
[*] Method for tensile testing of steel products other than sheet, strip, wire and tube.

[†] Methods of Charpy impact test (U-notch) for steel.

[‡] Method for end quench test for hadenability of steel.

[§] Method of determining austenitic grain size of steel.



All dimensions in millimetres.

FIG. 1 LOCATION OF THE TEST PIECES IN THE PRODUCTS

11. DIMENSIONAL TOLERANCES

11.1 Dimensional tolerances for hot rolled steel products shall be in accordance with IS : 3739-1972*.

12. SAMPLING

12.1 Sampling for Chemical Analysis — The ladle analysis shall be supplied by the producer. If a product analysis is required by the purchaser, at least one sample product shall be taken from each cast.

12.1.1 For product analysis, the selection of samples shall be carried out in accordance with 'Indian Standard method for selection of samples for steels' (*under preparation*).

NOTE — Until the above standard is published, the selection of samples shall be as agreed to mutually between the purchaser and the manufacturer.

12.2 Sampling for Hardness in the Annealed or Normalized Condition — One sample product shall be taken from each heat treatment batch, subject to the minimum of at least one sample from each cast for the determination of hardness.

12.3 Sampling for Mechanical Properties — If the material is supplied on the basis of properties of test bars after heat treatment, one sample product shall be taken from each size grouping of each heat treatment batch for testing.

12.3.1 Test pieces for mechanical tests shall be taken in the longitudinal direction of the product in accordance with Fig. 1.

12.4 General conditions for selection and preparation of samples and test pieces shall be in accordance with IS : 3711-1966†.

13. RETESTS

13.1 Retest for Product Analysis — If the results of the product analysis do not meet the composition requirements given in Table 2 and **5.2**, unless otherwise agreed to between the purchaser and the manufacturer, two new samples shall be taken on different pieces from the same cast. Should the two analysis satisfy the requirements, the lot represented shall be accepted. Should either of the tests fail, the material shall be taken as not complying with this standard.

13.2 Retest for Hardness in the Normalized/Annealed Condition — If the samples selected under **12.2** fail to meet the requirements under **7**, two further samples shall be selected from the same heat treatment batch. The consignment shall be considered to conform to the requirements if both the additional tests are satisfactory. Should either of the samples fail, the manufacturer shall have the right if he so desires, to re-heat-treat the product in any suitable manner before two fresh samples are taken for testing. Should the two tests satisfy the requirements of this standard, the lot represented shall be accepted. Should either of the samples fail, the material shall be taken as not complying with this standard.

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*Dimensional tolerances for carbon and alloy constructional steel products.

†Method for selection and preparation of samples and test pieces for mechanical tests for wrought steel.

13.3 Retest for Mechanical Test for Test Pieces — If the samples selected under **12.3** fail to meet the requirements under **8**, two further samples shall be selected from the same size grouping for making fresh test bars. The fresh test bars shall be heat treated and tested. The consignment shall be considered to conform to the requirements if both the additional tests are satisfactory. Should either of the test pieces fail, the material shall be taken as not complying with this standard.

14. MARKING

14.1 Each billet or bar over 50 mm diameter or of equivalent cross sectional area, shall be stamped or suitably marked at one end indicating the cast number or any other identification mark by which steel can be traced to the cast and heat treatment batch from which it was made.

14.2 Bars of 50 mm diameter or equivalent cross section and below shall be bundled as agreed to between the purchaser and the manufacturer. The metal tag attached to each bundle shall be marked as given in **14.1**.

14.3 The colour scheme in accordance with IS : 2049-1963* or as required by the purchaser may be adopted to mark the grade of the material.

14.4 The material may also be marked with the Standard Mark.

NOTE — The use of the Standard Mark is governed by the provisions of the Bureau of Indian Standards Act, 1986 and the Rules and Regulations made thereunder. The Standard Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well defined system of inspection, testing and quality control which is devised and supervised by BIS and operated by the producer. Standard marked products are also continuously checked by BIS for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

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*Colour code for identification of wrought steels for general engineering purposes.

APPENDIX A

(*Clause* 0.2)

INFORMATION TO BE SUPPLIED BY THE PURCHASER

A-1. BASIS FOR ORDER

A-1.1 While placing an order for the steels covered by this standard, the purchaser should specify clearly the following:

a) Grade;
b) Condition of delivery;
c) Size;
d) Tests required;
e) Special requirements such as bundling and packing;
f) Method of manufacture; and
g) Test report, if required.

APPENDIX B

(*Clauses* 6.1.1, 6.2, 6.3 *and* 8.1)

RECOMMENDED HEAT TREATMENT FOR CHAIN STEELS

Steel Designation	Normalizing Temperature	Annealing Temperature	Quenching Temperature	Quenching Agent	Tempering Temperature
	0°C	0°C	0°C		0°C
C15Mn$\underline{75}$	880-950	880-950	900-950	Water quench	600-650 air cool
C25Mn$\underline{75}$	850-900	850-900	850-900	Oil or water quench depending on section size	550-660 air cool
C30	860-890	860-890	860-890	Water or oil	550-660 air cool
20Mn2	860-900	860-900	860-900	Water or oil	550-660 air cool
20Ni55Cr$\underline{50}$ Mo$\underline{20}$	850-880	—	Blank carburize at 880-930°C quenched from 820-840°C in oil		

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